Limited Visual Dam Safety Inspection Summary Report

MA-126

Kahana Dam

Maui, Hawaii

Prepared by:

U.S. ARMY CORPS OF ENGINEERS
HONOLULU ENGINEER DISTRICT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

May 2006

Dam ID: MA-126
Name: Kahana Dam

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

I. Purpose

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections are authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections are being conducted under joint agreements of the U.S. Army Corps of Engineers (USACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection will be made on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works would include the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may appear to be no immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

V. Inspection Team

Organization	Name /Title
U.S. Army Corps of Engineers	Jon Kolber Geotechnical Engineer
State of Hawaii, Dept of Land and Natural Resources	Eric Yuasa Civil Engineer
USDA Natural Resource Conservation Service	Michael Hayama Civil Engineer
USDA Natural Resource Conservation Service	Diana Perry Civil Engineer

VI. Owner's Representatives Present

Maui County, Public Works Dept.	Leonard Costa Ed Bonnell

VII. Summary Report Team

Organization	Name
U.S. Army Corps of Engineers	Derek Chow Bill Empson
State of Hawaii, Dept of Land and Natural Resources	Denise Manuel Edwin Matsuda

VIII. Dam Type

The dam appeared to be an earthen embankment dam.

IX. Dam Classification

The current hazard classification of this dam is: High

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Most likely Intermediate

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

X. Summary of Inspection

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

Dam ID: MA-126
Name: Kahana Dam

A. General appearance:

This dam was completed in 1984 and continues to operate as a sediment retention structure. The dam is 50 feet high and 500 feet long. The reservoir appears to have a significant drainage area.

The dam has been modified with the addition of a hydraulic outlet valve.

A dam safety incident occurred when transverse and axial cracks formed in the crest that attributed to differential settlement near the abutment. Cracks were filled with sand.

Findings and Corrective Actions:

a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
b. An Emergency Action Plan (EAP) is on file with the department. Submit any updates as applicable.
c. Routine inspection logs were not inspected.
d. Dam owners shall provide for routine inspection of the dam.
e. Access to site appears to be satisfactory.
f. Access to the dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or provide access.
g. Access is not possible during emergency spillway flow, since the access is along the emergency spillway.
h. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of sudden or unprecedented flood or unusual or alarming circumstance or occurrences, which may adversely affect the dam or reservoir.
i. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
j. Power / Communication: There were no communication systems observed on this reservoir.

B. Access / Security:

Access to the dam was accomplished by driving along the emergency spillway to the crest. A four-wheel drive vehicle is not required under normal circumstances. A four-wheel drive vehicle is required during severe weather. The dam is inaccessible during emergency spillway flow.

Security issues. Access to the dam is unrestricted.

C. Intake Works: (Fair)

Water flows into the reservoir through a DIP pipe which was inaccessible during this inspection, since the top of the metal valve box is attached to the valve box), as well as a stream channel which flows into the reservoir. The DIP pipe is controlled by a valve.

Findings and Corrective Actions:
a. The intake works were not inspected.
b. The intake works appeared to be in fair to poor condition and requires corrective action.
c. Access should be provided to inspect the valve box and DIP.
d. Clear vegetation around valve box.

D. Reservoir: (Fair)
The water level in the reservoir was estimated as about 8 feet deep at the time of inspection, which is the normal level. The owner said the outlet valve is broken and left in an open position at all times. There was no staff gage in the reservoir.

Findings and Corrective Actions:
a. The reservoir appeared to be in fair to poor condition and requires corrective action.
b. A staff gage was not observed in the reservoir. Provide some method of quantifying the water level within the reservoir.

E. Upstream Slope: (Fair)
The upstream slope is covered with grass on a 3 on 1 slope. The slope is covered by tall grass, which was not mowed due to the recent wet weather.

Findings and Corrective Actions:
a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
b. Slope protection needs maintenance. The tall grass needs to be mowed and maintained on a regular basis.
c. The upstream slope was not visible due to high grass. Clear high vegetation and maintain low to enable easy visual inspection.

F. Crest: (Fair)
This crest of the dam is approximately 15 feet wide, accessible by walking. At the time of this inspection, the crest was covered by tall grass. Per Michael Hayama of Hawaii DLNR, transverse and axial cracks formed in the crest of this dam near the abutment several years after it was constructed. The cracks were attributed to differential settlement between the crest and the abutment. The cracks were repaired by filling with sand. They have not recurred since they were repaired.

Findings and Corrective Actions:
a. The dam crest appeared to be in fair to poor condition and requires corrective action.
b. Portions of the crest were not visible due to high grass. Clear high vegetation and maintain low to enable easy visual inspection.

G. Downstream Slope: (Fair)

This downstream slope is approximately 2.5 on 1. It is covered by tall grass as well as some small trees.

Findings and Corrective Actions:

a. The downstream slope appeared to be in fair to poor condition and requires corrective action.
b. Slope protection needs maintenance. The tall vegetation needs to be mowed.
c. The downstream slope was not visible due to high grass. Clear high vegetation and maintain low to enable easy visual inspection.
d. Trees were observed on the downstream slope. Trees have been identified as the probable cause of piping failures and can possibly cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2-inch diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of a licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

H. Abutments / Toe: (Fair)

The abutments and toe were obscured by tall grass and trees at the time of this inspection.

Findings and Corrective Actions:

a. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
b. Slope protection needs maintenance (mowing).
c. The abutment area was not visible due to tall vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
d. Trees were observed along the abutment/toe. Trees have been identified as the probable cause of piping failures and can cause severe damage to the embankment if they are uprooted during high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root down to a 2-inch diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of a licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Fair)
The outlet works consist of an 8-foot by 20-foot concrete box culvert with energy dissipaters below the dam. Outflow is controlled by a rectangular concrete overflow weir upstream of the dam. The energy dissipaters on the left side were covered by vegetative debris at the time of this inspection, greatly reducing their effectiveness.

Findings and Corrective Actions:
a. The outlet works were not inspected. (Due to vegetation)
b. The outlet works were not tested.
c. The outlet works appeared to be in fair to poor condition and requires corrective action.
d. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
e. The debris should be removed from the energy dissipaters to restore their full function.

J. Spillway: (Satisfactory)
This emergency spillway consisted of an approximately 25 foot wide earthen channel, which circled around the left abutment.

Findings and Corrective Actions:
a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

K. Down Stream Channel: (Unknown)
The downstream channel is a non-defined drainage-way, which caries flow beneath the highway to the ocean.

Findings and Corrective Actions:
a. The downstream channel was not inspected.

XI. Additional Comments:

Based on visual observations and discussion of operational procedures of the day, there is no immediate threat to the safety of the dam at this time.

PHOTOGRAPHS

MA-126 Kahana Reservoir

MA-126 Kahana Reservoir

126 Crest - Looking along the crest of Kanaha Dam. Note the tall grass.

MA-126 Kahana Reservoir

126 View of the downstream slope of Kanaha Dam. Note the tall grass.

MA-126 Kahana Reservoir

126 View from the crest of Kanaha dam looking downstream at the outlet channel

MA-126 Kahana Reservoir

126 View of Kanaha Dam reservoir looking from the crest

MA-126 Kahana Reservoir

126 View of upstream slope of Kanaha Dam. Note the tall grass.

FIELD INSPECTION SHEETS

Dam ID: MA-0126
KAHANA DAM

Vulnerability Index:
Extreme 1 | High 2 | Moderate 3 | Low 4

Inspection No: _____
Date: 4/04/2006

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present	Affiliation	Phone Number
Jon Kolber	US Army Corps of Engineers	
Leonard Costa	County of Maui	
Ed Bonnell	" "	
Eric Yuena	Hawaii DLNR	
Diana Perry	USDA/NRCS	
Michael Hoyama	Hawaii DLNR	

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry

Comments: _____

---

1. General: *(Information currently on file, update as required)*

Dam/Res. Name	KAHANA DAM		
Owner	Maui County, Department of Public Works		*(C021)*
Owner Contact	Mr. Leonard B. Costa	Owner Ph.	
Lessee	N/A	Lessee Ph.	
O & M Contractor	Owner	O & M Ph.	
Nearest Town	KAHANA	Latitude	20.98 ° (decimal)
County	MAUI	Longitude	156.6767 ° (decimal)
Tax Map Key(s)			

Dam Status	A:	Hazard Potential	H:	Dam Size	
Year Completed	1984	Dam Length	500 ft.	Dam Height	50 ft.
Normal Storage	59 ac.ft.	Max. Storage	225 ac.ft.	Max. Surface Area	5.6 ac.
Drainage Area	4.83 mi.	Spillway Type		Max. Spillway Q	25884 cfs

Owner owns land under dam facility: _____
Emergency Action Plan on file with the Department: YES
Reports on file with the Department: July 1996 = Dam Safety Inspection, Woodward Clyde & Assoc. (7)

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	☒	☐	☐	
Site / Facility Map	☒	☐	☐	
Operation & Maintenance Manual	☐	☒	☐	
Emergency Action Plan	☐	☒	☐	
Modifications / Improvements	☒	☐	☐	Hydraulic Outlet Valve Added
Conduct Routine Inspections	☒	☐	☐	
Conduct Routine Maintenance	☒	☐	☐	
Vehicle access to site	☒	☐	☐	☐ Not accessible ☒ With Standard car ☐ Requires 4-Wheel Drive
Access during heavy rains	☒	☐	☐	☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive
Access when spillway is flowing	☐	☒	☐	☒ Not accessible ☐ With Standard car ☐ Requires 4-Wheel Drive
Other Studies Conducted	☐	☒	☐	☐ Phase I ☐ Phase II ☐ Hydraulics ☐ Stability ☐ Hazard ☐ Seismic ☐ Other: _____
Incident History	☒		☐	☐ Breached ☐ Overtop ☐ Slide ☐ Down stream Flooding ☒ Other: CRACKING (SEE P.5)
Reservoir's Current Use	☒	☐	☐	☒ Sediment ☐ Irrigation ☐ Recreation ☐ Flood Control ☐ Drinking Water ☐ Power Generation ☐ Other: _____

Findings and Corrective Actions:

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☒ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☐ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☒ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☒ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☒ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☒ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☐ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☐ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☒ o. Access not possible during emergency spillway flow. Access is through emergency spillway.

Additional Requirements:

The following investigative study(s) are:

Required	Recommended	
☐		Phase I Study
☐	☐	Phase II Study (Including ☐ Seepage ☐ Hydrology/Hydraulics ☐ EAP)
☐	☐	Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)
☐	☐	Stability Analysis
☐	☐	Seismic Analysis
☐	☐	Hazard Classification
☐	☐	Other: _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection 8' ft per EYE (gage / other)

Normal Operating Level/Range 8' ft per EYE (gage / other)

Description: _____

Typical Operation ☐ Spillway always flowing ☐ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms ☒ Other: OUTLET VALVE IS ALWAYS OPEN (BROKEN)

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Staff Gage: Description: NONE

Findings:

☐ a. The reservoir was not inspected.
☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☒ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ e. The staff gage needs maintenance and/or repair. Description: _____
☒ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☒ Number of Intakes 2
☒ Intake Culvert / Pipe
Size: N/A in. ☒ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other NOT VISIBLE
Control: ☐ Gate ☒ Valve ☒ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other VALVE BOX NOT ACCESSIBLE FOR INSPECTION (~~VEGETATION~~).

☒ Ditch / Flume
Dimension: _____ (Size x Depth) Shape STREAM CHANNEL (METAL PLATE OVER THE VAVE BOX)
Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

Findings:

☒ a. The intake works were not inspected.
☒ b. The intake works were not tested.
☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☒ f. The intake works needs maintenance and/or repair. Description: CLEAR VEGETATION
☐ g. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

5. Upstream Slope: (Typical Slope ± 3H : 1V)

Slope Protection: ☒ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner _____ ☐ Other: _____
☐ Defect in Protection: Description: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed
Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☒ Not Visible ☐ None Observed
Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Findings:

☐ a. The upstream slope was not inspected.
☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
☒ c. The upstream slope appeared to be in fair to poor condition and requires corrective action. NEEDS MOWING
☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☒ e. Slope protection needs maintenance or repair. Description: MOWING (TOO WET TO MOW)
☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
☒ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ k. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

6. Crest: Approximate Crest Width: 15'

Access: ☐ None ☒ Walking Path ☐ Roadway, Surface / Width / Usage: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed
Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: NEEDS TO BE MOWED (TOO WET)

Findings:

☐ a. The dam crest was not inspected.
☐ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
☒ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Access along the crest was satisfactory.
☐ f. Access along the crest was not possible. Description: _____
☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
☒ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☒ l. PER MICHAEL HAYAMA OF DLNR, TRANSVERSE & AXIAL CRACKS FORMED IN THE CREST SEVERAL YEARS AFTER CONSTRUCTION, ATTRIBUTED TO DIFFERENTIAL SETTLEMENT NEAR THE ABUTMENT. THESE CRACKS WERE FILLED WITH SAND. THEY HAVE NOT RECURRED.

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

7. Downstream Slope: (Typical Slope ± 2½H: 1V)

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☒ walkway to outlet works ☐ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☒ Not Visible ☐ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees # 15-20 ☒ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage:

Seep Spot Number 1

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☐ a. The downstream slope was not inspected.

☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

☒ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.

☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☒ e. Slope protection needs maintenance or repair. Description: THE SLOPE NEED MOWING

☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____

☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.

☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.

☒ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☒ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.

☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.

☐ k. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☒ Not Visible ☐ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☒ Not Visible ☐ None Observed
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☒ Bushes or Tall Grass ☒ Trees #SEVERAL ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Seepage:
Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

☐ a. The abutments/toe were not inspected.
☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
☒ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☒ e. Slope protection needs maintenance or repair. Description: NEEDS TO BE MOWED
☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☒ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☒ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☐ l. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

9. Outlet Works:

Culvert / Pipe

Type / Size: BOX CULVERT 8'X20' WITH ENERGY DISSIPATOR

Culvert: ☒ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☐ Valve ☐ Other OVERFLOW WEIR

Location: ☒ Control on Upstream side ☐ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☒ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☒ a. The outlet works were not inspected. DUE TO VEGETATION

☒ b. The outlet works were not tested.

☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

☒ d. The outlet works appeared to be in fair to poor condition and requires corrective action. (i)

☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.

☒ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☒ i. ENERGY DISSIPATORS ON LEFT SIDE COVERED BY VEGETATIVE DEBRIS - SHOULD BE REMOVED TO RESTORE FUNCTION.

☐ j. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No: _____
Date: 4/04/2006

(EMERGENCY)

10. Spillway:

Type: ☐ None ☐ Culvert/Pipe ☒ Channel

Description: _____

Dimension: 25 ft. Invert elevation: _____ ft. per staff gage

Slope Protection: ☒ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Concrete

☐ Defect in Protection: Description: _____

Approach: ☒ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: _____

Description: _____

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

☒ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.

☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ d. Slope protection needs maintenance or repair. Description: _____

☐ e. The spillway approach was blocked. Clear approach.

☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____

☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.

☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.

☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.

☐ j. _____

11. Down Stream Channel:

Name: _____

Downstream: ☐ Sump ☐ Open Area ☒ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☐ None ☒ Road ☒ Houses ☐ Town ☐ Not Inspected

Description: _____

Findings:

☒ a. The downstream channel was not inspected.

☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.

☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

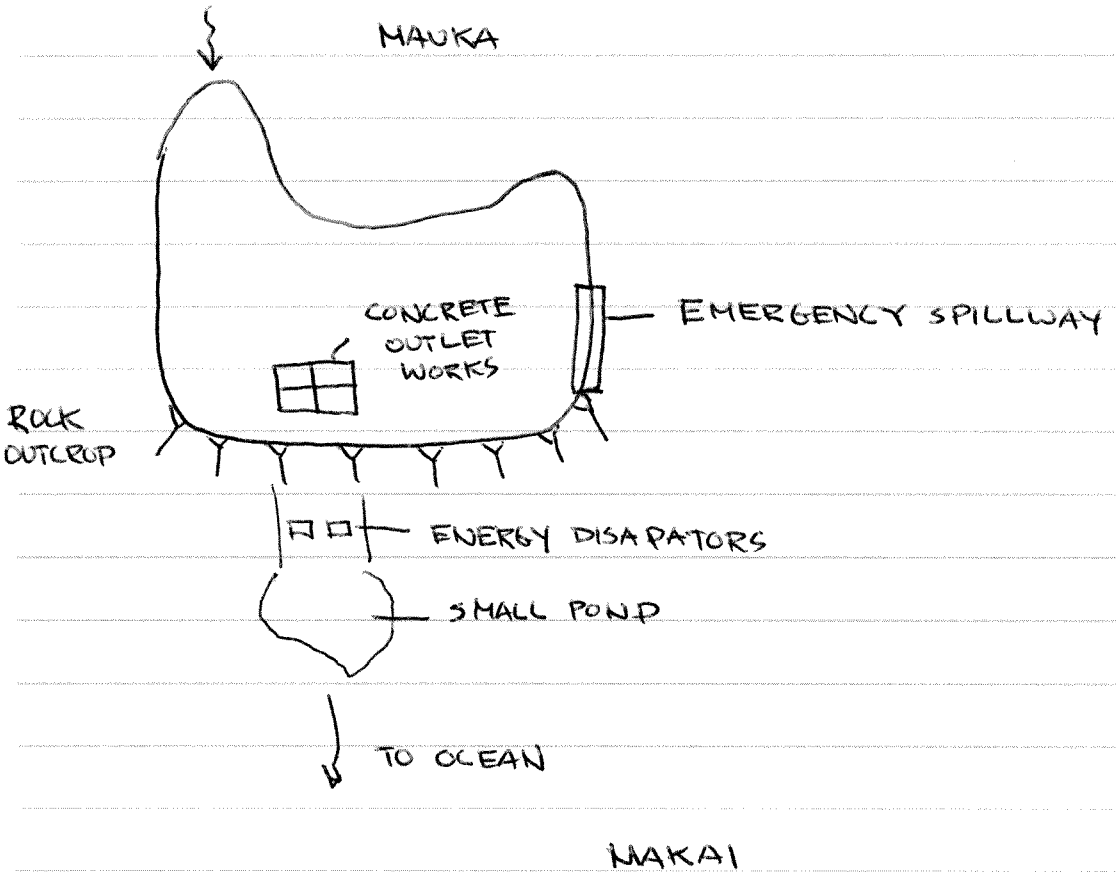
☐ e. _____

Dam ID: MA-0126
KAHANA DAM

Inspection No:
Date: 4/04/2006

Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.



Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003